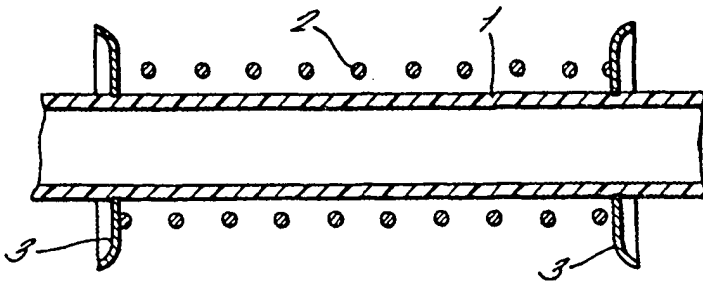


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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<p>(21) International Application Number: PCT/GB00/00959</p> <p>(22) International Filing Date: 15 March 2000 (15.03.00)</p> <p>(30) Priority Data: 9906014.7 16 March 1999 (16.03.99) GB</p> <p>(71) Applicant (for all designated States except US): MASSTECH INTERNATIONAL LIMITED [GB/GB]; 20 Pensford Close, Crowthorne, Berkshire RG45 6QR (GB).</p> <p>(72) Inventor; and (75) Inventor/Applicant (for US only): BRIDGES, Robert [GB/GB]; 20 Pensford Close, Crowthorne, Berkshire RG45 6QR (GB).</p> <p>(74) Agent: BOULT WADE TENNANT; Verulam Gardens, 70 Gray's Inn Road, London WC1X 8BT (GB).</p>	<p>(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).</p> <p>Published With international search report.</p>	
<p>(54) Title: A DEVICE FOR DETECTING THE PRESENCE OF A CHEMICAL CONTAMINANT</p> <p>(57) Abstract</p> <p>The disclosure relates to a device for detecting the presence of a chemical contaminant. The device comprising a resilient indicator element (2, 6) which is biased into a first position and is anchored in the first position by means of a failure element (1, 5). The failure element is made of a material which fails in the presence of a chemical to be detected, thereby releasing the indicator element from its first position and allowing it to move under its own resilience into a second position in order to provide an indication of the presence of the contaminant.</p> 		

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A DEVICE FOR DETECTING THE  
PRESENCE OF A CHEMICAL CONTAMINANT

5           The present invention relates to a device such as  
an indicator, switch or actuator for detecting the  
presence of a chemical contaminant. Such a detector  
is used, for example, in filling stations and chemical  
plants to detect the presence of unwanted chemicals.

10           Chemical detection devices are frequently  
electronic and therefore have to be designed to be  
intrinsically safe making them prohibitively expensive  
for many applications and are dependent on the  
15           reliability of the power supply. Further, recent  
surveys in filling stations have shown that many of  
these devices have been physically disabled or no  
longer function for other reasons.

20           The present invention aims to provide a low cost,  
disposable device which does not require electricity.

          According to a first aspect of the present  
invention there is provided a device for detecting the  
25           presence of a chemical contaminant, the device  
comprising an indicator element which is held in a  
first position by means of a failure element which is  
held in tension, the failure element being made of a  
material which fails in the presence of the chemical  
30           to be detected, thereby releasing the indicator  
element from its first position and allowing it to  
move into a second position in order to provide an  
indication of the presence of the contaminant.

35           According to a second aspect of the present  
invention, which may be independent of, or used in

conjunction with the first aspect of the invention, there is provided a device for detecting the presence of a chemical contaminant, the device comprising a resilient indicator element which is held in a first position and is anchored in the first position by means of a failure element, the failure element being made of a material which fails in the presence of the chemical to be detected, thereby releasing the indicator element from its first position and allowing it to move into a second position in order to provide an indication of the presence of the contaminant; wherein the failure element is elongate in the sense that it is larger in the direction in which the indicator element moves on failure of the failure element than it is in any other dimension.

The device is based on simple chemistry and therefore cannot fail to work upon contact with the chemical to be detected. The device can be made very simple in construction allowing it to be produced very cheaply.

At present, when monitoring wells, it is necessary to take a sample from every well to determine whether or not contamination has occurred. With the present invention it would only be necessary to take samples from wells where the element has failed.

With the first aspect of the invention, as the failure element is held in tension, a failure, no matter how small, anywhere along the failure element, will cause the device to indicate the presence of a contaminant.

With the second aspect of the invention, as the failure element is elongate (for example, the length

of the failure element in the direction in which the indicator element moves on failure is at least 3 . times, preferably at least 10 times, more preferably at least 20 times, and most preferably at least 50 times its size in any other dimension), it can be extended across a zone in which chemical contaminant is to be detected, thereby providing a cost effective way of detection beyond a single location.

10           The indicator element may be held in the first position by a biasing force, the biasing force acting to move the indicator element to the second position upon failure of the failure element. Alternatively, the indicator element is held in the first position by  
15           a biasing force and wherein a further force, which is strong enough to override the biasing force is arranged to act on the indicator element to move it to the second position upon failure of the failure element.

20           In its simplest form the indicator element is a spring which is fixed to the failure element, the spring being under compression, such that the failure element is under tension. The failure element is preferably a tubular member. In order to provide a further degree of monitoring of the condition of the failure element, the tubular member is preferably sealed, the inside of the tubular member is maintained at a pressure other than atmospheric, and means are provided to monitor this pressure to determine the  
30           integrity of the tubular member. In order to operate a valve, a cable can pass through the tubular member and be fixed to one end of the spring such that, on failure of the failure element the cable is pulled  
35           through the tubular member to operate the valve. The spring is preferably attached to the failure element by a respective washer at each end of the spring, each

- 4 -

washer being anchored to the failure element so as to be capable of movement in only one direction along the failure element. This allows the indicator element to be fastened in place with the necessary preload by pushing each washer along the failure element. The washer will then be held in place as the spring will tend to urge it in the direction in which it cannot move.

10           In order to assist with an assessment of the full extent of a chemical contaminant, the failure element is preferably made of a material which changes its appearance in the presence of the contaminant.

15           Preferably, the failure element is a tubular element and the indicator element is within the tubular element and is fixed at one end to the failure element, while its other end projects beyond the other end of the failure element and is biased away from the other end of the failure element.

20           The further force may be any type of force, such as a magnetic force. However, preferably, the failure element and indicator element are arranged to be supported vertically, wherein the further force is gravity.

25           In an alternative arrangement the indicator element comprises a core surrounded by a sleeve, the sleeve being biased away from the core, wherein the failure element holds the sleeve in a position in which it surrounds the core, whereby, when the failure element fails, the sleeve is released and moved away from the core providing a visual indication of the presence of the contaminant. Preferably, the outer surface of the sleeve is a different colour from the outer surface of the core, thereby improving the

visual indication of the presence of a contaminant.

In addition to the provision of visual indication, the device can also be arranged to operate  
5 some failsafe mechanism to prevent further contamination, such as by automatically closing a valve.

In its simplest form, the failure element is made  
10 of a single material which fails in the presence of a single contaminant. However, more complex devices are envisaged where the failure element comprises a number of different materials arranged in series and/or in parallel. With different materials arranged in  
15 series, the device will operate when any one of a number of contaminants to which a single material is responsive, is present. A parallel arrangement, on the other hand, will only fail when contaminants to which all of the materials are responsive are present.  
20 With a combination of series and parallel materials, a device can be tailored to detect a sophisticated selection of contaminants.

In order to detect the presence of a contaminant,  
25 several of the devices described above are arranged over the area, preferably in parallel. This allow a map of the location and extent of a contaminant to be created.

30 Examples of devices constructed in accordance with the present invention will now be described with reference to the accompanying drawings, in which:

Fig. 1 is a schematic cross-section of a first  
35 example;

Fig. 2 is a cross-section of a second example;

Fig. 3 is a cross-section of a ground water monitoring well having a device according to the present invention;

5

Fig. 4 shows a device according to the present invention positioned under a tank in order to monitor leakage from the tank;

10

Fig. 4A is a detail of the part ringed as 4A in Fig. 4; and

15

Fig. 5 is a schematic plan view showing the operation of Fig. 4 to determine the full extent of contaminant leakage.

20

The device shown in Fig 1 comprises a tubular member 1 of high-density polystyrene. Attached to the tubular member 1 is a spring 2 which is held in compression by a pair of starlock washers 3 which anchor it to the tubular member 1. In the presence of a chemical contaminant, in this case any petroleum product, the tubular member 1 will fail and the spring 2 extends. The extension of the spring can be used to trigger a mechanical signal or alarm, or can close valves. A cable, such as a bowden cable, may extend through the tubular element and be fixed to one end of the starlock washers. On failure of the tubular member, the cable will be pulled through the tubular element allowing operation of a valve. The failure made may be shearing, stretching or bending of the tubular member, but is more likely to be slippage of a starlock washer when the surface of the tubular member has been degraded by the contaminant.

35

A second example is shown in Fig 2. In this case, the device is built around a central rod 4 on



which are threaded three failure elements 5 of expanded polystyrene, and a resilient indicator element 6. The failure elements 5 and resilient indicator element 6 are held in place by a pair of starlock washers 7. The resilient indicator element 6 comprises a sleeve 8 surrounding a core 9. The sleeve 8 and core 9 are biased away from one another by compression spring 10. When any one of the failure elements 5 fails in the presence of a chemical contaminant, the compression of spring 10 forces the sleeve 8 and core 9 axially away from one another, so that the outer surface of the core 9 is uncovered providing a visual indication that failure has occurred.

15

A third example is shown in Fig. 3. This shows a device used in a ground water monitoring well which is buried below ground level 11. The well comprises a slotted or perforated well casing 12 closed at its top end by a well monitoring cap 13. In this case, the failure element 14 is a tubular member which is suspended from the cap 13 and fixed at its bottom end to a weight 15. The indicator element comprises an elongate rod 16 extending within the failure element 14 and attached at its lower end to the weight 15, and a spring 17 mounted in the cap 13 and acting to bias the rod 16 upwardly.

The lower part of the well is filled with ground water 18. If a chemical contaminant 19 is present floating on the ground water 18, this will react chemically with the failure member 14 causing it to fail. At this time, the full mass of the weight 15 is held by the rod 16 which will be pulled downwardly under gravity compressing spring 17 and providing a visual indication at the well cap of the presence of the contaminant.

35

When monitoring a well, the device could be several metres long, so that no matter at what level the hydrocarbon contaminant existed, the element would fail.

A fourth example is shown in Figs. 4, 4A and 5. This example is designed to detect leakage from a tank 20. A plurality of elongate devices are buried in the ground 21 beneath the tank 20. Fig. 4 shows one such indicator, and the arrangement of all of the indicators is shown in plan in Fig. 5. The device comprises a perforated tube 22 containing elongate failure element 23 which projects from one end of the perforated tube 22 and is fastened at the other end of the tube 22. A spring 24 providing the indicator element is provided to bias a starlock washer 25 attached to the end of the failure element 23 away from a washer 26 at the end of the perforated tube 22 hence holding the failure element in tension.

When a chemical contaminant 27 leaks from the tank 20, it will enter the perforated tubes 22 immediately below the leak and will cause certain failure elements 23 to fail. Once a failure element 23 fails at any location, the spring 24 which is held in compression, will push the starlock washer 25 away from the end of the tube 22 thereby providing a visual indication of the presence of a contaminant. Once a contaminant is detected, all of the failure elements 23 can be pulled out and inspected. If they are made of a material which changes its appearance or is entirely obliterated in the presence of the contaminant, it is possible to build up a map showing the location and extent of the contaminant 27 as shown in Fig. 5.

CLAIMS:

1. A device for detecting the presence of a chemical  
contaminant, the device comprising an indicator  
5 element which is held in a first position by means of  
a failure element which is held in tension, the  
failure element being made of a material which fails  
in the presence of the chemical to be detected,  
thereby releasing the indicator element from its first  
10 position and allowing it to move into a second  
position in order to provide an indication of the  
presence of the contaminant.
2. A device according to claim 1, wherein the  
15 indicator element is held in the first position by a  
biasing force, the biasing force acting to move the  
indicator element to the second position upon failure  
of the failure element.
- 20 3. A device according to claim 2, wherein the  
biasing force is provided by the resilience of the  
indicator element.
- 25 4. A device according to claim 3, wherein the  
resilient indicator element is a spring which is fixed  
to the failure element, the spring being under  
compression, such that the failure element is under  
tension.
- 30 5. A device according to any preceding claim,  
wherein the failure element is a tubular member.
6. A device according to claim 5, wherein the  
tubular member is sealed, the inside of the tubular  
35 member is maintained at a pressure other than  
atmospheric, and means are provided to monitor this  
pressure to determine the integrity of the tubular

member.

7. A device according to any one of claims 4 to 6, wherein the spring is attached to the failure element by a respective starlock washer at each end of the spring each washer being anchored to the failure element so as to be capable of movement in only one direction along the failure element.
8. A device according to any one of the preceding claims, wherein the failure element is made of a material which changes its appearance in the presence of the contaminant.
9. A device according to claim 1, wherein the indicator element is held in the first position by a biasing force and wherein a further force, which is strong enough to override the biasing force is arranged to act on the indicator element to move it to the second position upon failure of the failure element.
10. A device according to claim 9, wherein the failure element is a tubular element and the indicator element is within the tubular element and is fixed at one end to the failure element, while its other end projects beyond the other end of the failure element and is biased away from the other end of the failure element.
11. A device according to claim 9, wherein the failure element and indicator element are arranged to be supported vertically, wherein the further force is gravity.
12. A device according to any one of the preceding claims, wherein the failure element comprises a number

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of different materials arranged in series and/or in parallel.

13. A device for detecting the presence of a chemical  
5 contaminant, the device comprising a resilient  
indicator element which is held in a first position  
and is anchored in the first position by means of a  
failure element, the failure element being made of a  
10 material which fails in the presence of the chemical  
to be detected, thereby releasing the indicator  
element from its first position and allowing it to  
move into a second position in order to provide an  
indication of the presence of the contaminant; wherein  
15 the failure element is elongate in the sense that it  
is larger in the direction in which the indicator  
element moves on failure of the failure element than  
it is in any other dimension.

14. A device according to claim 13, wherein the  
20 failure element is held in tension.

15. A device according to claim 13 or claim 14,  
wherein the indicator element is held in the first  
position by a biasing force, the biasing force acting  
25 to move the indicator element to the second position  
upon failure of the failure element.

16. A device according to claim 15, wherein the  
biasing force is provided by the resilience of the  
30 indicator element.

17. A device according to claim 16, wherein the  
resilient indicator element is a spring which is fixed  
to the failure element, the spring being under  
35 compression, such that the failure element is under  
tension.

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18. A device according to any one of claims 13 to 17, wherein the failure element is a tubular member.

5 19. A device according to claim 18, wherein the tubular member is sealed, the inside of the tubular member is maintained at a pressure other than atmospheric, and means are provided to monitor this pressure to determine the integrity of the tubular member.

10 20. A device according to any one of claims 17 to 19, wherein the spring is attached to the failure element by a respective starlock washer at each end of the spring each washer being anchored to the failure  
15 element so as to be capable of movement in only one direction along the failure element.

21. A device according to any one of claims 13 to 20, wherein the failure element is made of a material  
20 which changes its appearance in the presence of the contaminant.

22. A device according to claim 13, wherein the indicator element is held in the first position by a  
25 biasing force and wherein a further force, which is strong enough to override the biasing force is arranged to act on the indicator element to move it to the second position upon failure of the failure element.

30 23. A device according to claim 22, wherein the failure element is a tubular element and the indicator element is within the tubular element and is fixed at one end to the failure element, while its other end  
35 projects beyond the other end of the failure element and is biased away from the other end of the failure element.

24. A device according to claim 23, wherein the failure element and indicator element are arranged to be supported vertically, wherein the further force is gravity.

5

25. A device according to any one of claims 13 to 24, wherein the length of the failure element in the direction in which the indicator element moves on failure is at least 3 times, preferably at least 10 times, more preferably at least 20 times, and most preferably at least 50 times its size in any other dimension.

10

26. A device according to any one of claims 13 to 25, wherein the failure element comprises a number of different materials arranged in series and/or in parallel.

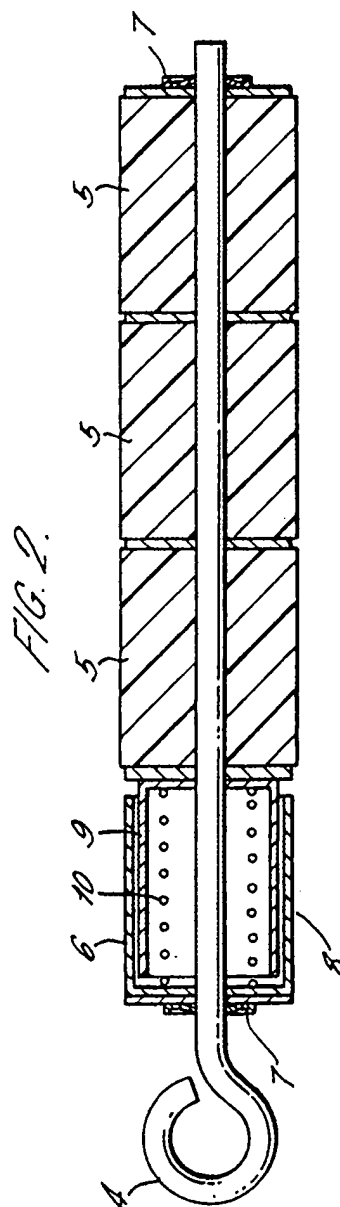
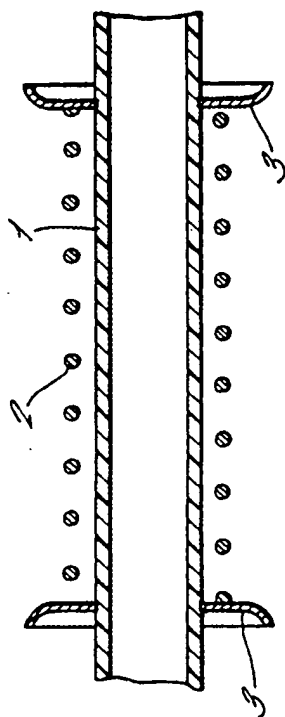
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27. An arrangement for detecting the presence of a chemical contaminant over a predetermined area, the arrangement comprising a plurality of devices according to any one of the preceding claims arranged over the area.

20

28. An arrangement according to claim 27, wherein the devices are arranged substantially in parallel.

25





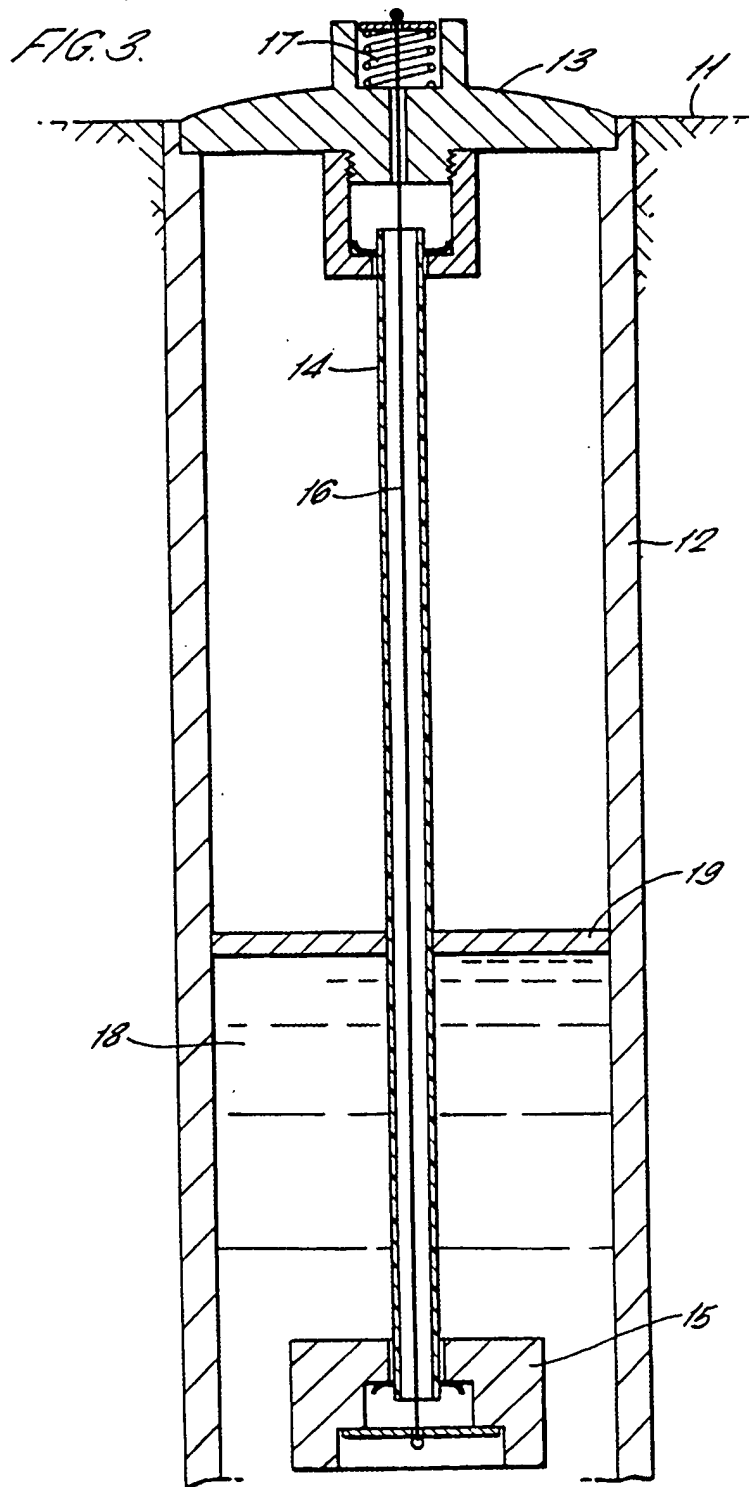


FIG. 4.

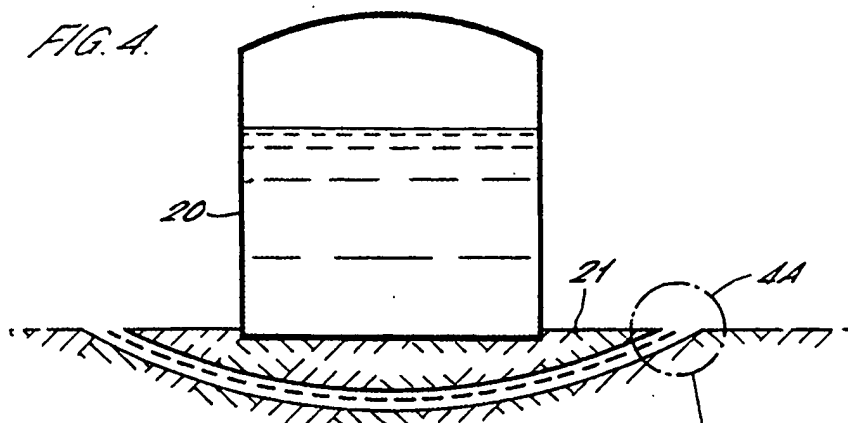


FIG. 4A.

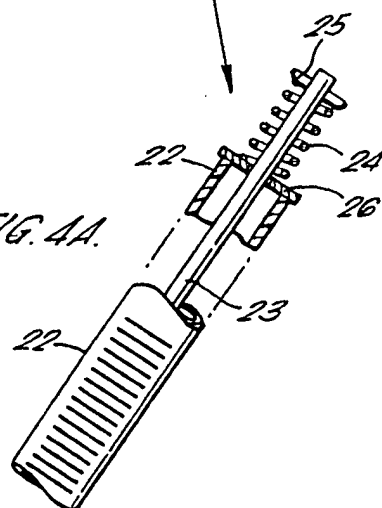
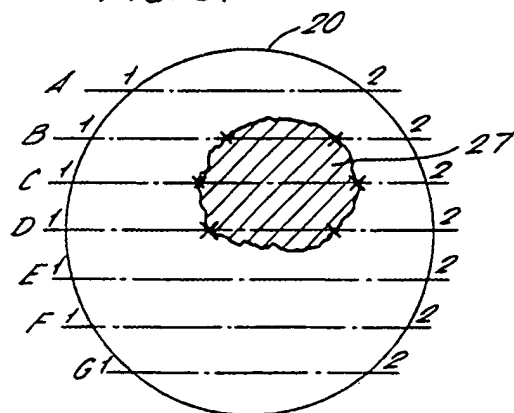


FIG. 5.



# INTERNATIONAL SEARCH REPORT

International Application No  
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A. CLASSIFICATION OF SUBJECT MATTER  
IPC 7 G01N17/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 846 795 A (JONES C) 5 November 1974 (1974-11-05) column 3 -column 4; figure 1	1-28
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A	US 5 728 943 A (RIZZO FRANK E ET AL) 17 March 1998 (1998-03-17). figures 1,2	1-28
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☒ Further documents are listed in the continuation of box C.

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Date of the actual completion of the international search

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# INTERNATIONAL SEARCH REPORT

Int. Application No  
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
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